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THE ZOOLOGIST:

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OF

NATURAL HISTORY

AND

JOURNAL FOR RECORDING FACTS & ANECDOTES

RELATING TO

QUADRUPEDS, BIRDS, REPTILES, FISHES, ANNELIDES,

INSECTS, WORMS, ZOOPHYTES, &c.

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MIGRATIONS, NESTS AND YOUNG.

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THE BRITISH FERNS

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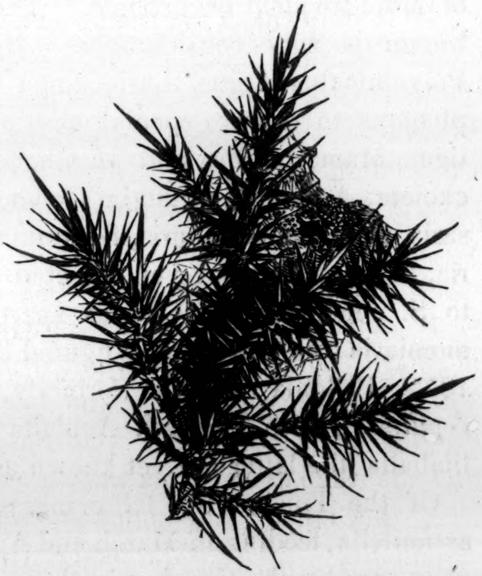
albicosta: the larva may be found in autumn and spring, but its case closely resembles a dried calyx of the plant, and it requires a very close scrutiny in order to distinguish it. One Lithocolletis, ulicicolella, frequents the furze, and no doubt the larva feeds on it, but hitherto we have failed to find it; indeed, the Germans have far outstripped us in their skill in finding Lithocolletis larvæ in Papilionaceous plants, and at present we are quite laggards in the race.

Ulex nanus. Dwarf Furze.

Probably most insects which feed on Ulex europæus feed also on this, but the observations of Mr. Brockholes and Mr. C. S. Gregson show that the larva of Butalis grandipennis has a decided preference for Ulex nanus. This larva may be found from January to April, in little webs near the stems of the twigs of the Ulex: an idea of the appearance which a shoot assumes, when furnished with a web made by one of these insects, may be gathered from the annexed woodcut. Within the last week I have found on this plant at Dartford Heath a fat greenish larva, inhabiting a more opaque white web, and which I am disposed to think must be the long-sought larva of Depressaria umbellana.



Genista tinctoria. Dyer's Weed.

Speyer mentions as feeding on this, Thecla Rubi, Anthrocera Minos, Hadena Genistæ and H. contigua, Calocampa exoleta and C. vetusta, Hemithea cythisaria and Boarmia crepuscularia. In May and June the shoots are contorted by the larvæ of Gelechia lentiginosella, which may then be collected in abundance, and at the same time the larvæ of Depressaria atomella may be met with, and the larvæ of Gelechia vorticella, and a little later the larvæ of Anarsia Genistæ; at the beginning of June the shining black cases of Coleophora vibicella should be sought for on this plant. Coleophora

BRITISH MUSEUM

Wockeella, which was suspected of feeding on Genista tinctoria, feeds on Stachys hirta, and perhaps on some other species of Stachys (hirta not being a British plant).

Genista anglica. Needle Whin.

More generally distributed, I believe, than the preceding species, but we are unacquainted with any larvæ that feed on it.

Sarothamnus scoparius. Broom.

This plant, which seems to have a great partiality for railway banks, is probably on that account much more plentiful with us than formerly, and the broom-feeding species ought, in consequence, to be of more frequent occurrence. The number of insects which feed on broom is very considerable. Speyer enumerates Thecla Rubi, Polyommatus Argus,* Lasiocampa Quercus (though this is too polyphagous to deserve special mention), Hadena Genistæ and H. contigua, Mamestra Pisi and M. Chenopodii, Calocampa vetusta and C. exoleta, Angerona prunaria, Geometra papilionaria, Hemithea cythisaria, Crocallis elinguaria, Boarmia crepuscularia, Speranza conspicuaria, S. spartiaria (not yet detected in this country, but closely allied to S. conspicuaria), Chesias spartiata, Cabera strigillaria, Eubolia mœniaria (the new species figured in the 'Entomologist's Annual' for 1855), Pellonia vibicaria (formerly, like Trochilium Chrysidiforme, a *reputed* British species), Acidalia aversata, Botys cinctalis and B. limbalis (the latter not yet known as British).

Of the Tineina the following may be mentioned:—Depressaria assimilella, feeding in March and April, and fastening together several twigs, not by the tips, but in the middle of their length; D. costosa and D. atomella, feeding on the leaves and flowers in May and June; Gelechia mulinella, feeding in April, in the same way that it feeds on the flowers of Ulex Europæus (Cleodora cytisella, though named after the broom, we suspect is attached to the common fern, *Pteris aquilina*); Anarsia Spartiella, feeding in the shoots; Gracilaria Kollariella (not yet found in this country) feeds on this plant, as well as on Lotus corniculatus, mining the leaves; Coleophora saturatella, the larva full-fed at the beginning of July,—the black case has numerous short projections; Lithocolletis scopariella no doubt feeds on this plant, but we have not yet detected either the larva or the mine; Cemiostoma spartifoliella forms tracks beneath the bark in winter and spring, and its snow-white cocoons may be found on the branches in May; and lastly, Trifurcula immundella is so manifestly attached to the broom that the larva must feed on some part of the plant.

Cytisus Laburnum. Laburnum.

Though no British plant, yet it grows well in most gardens, and there is a very fine tree of it in Torwood; the leaves are mined in July and autumn by the larvæ of Cemiostoma laburnella.

Ononis. Rest-Harrow.

As feeding on this genus of plants, Speyer enumerates Polyommatus Alexis, Polia tincta, Calocampa vetusta and C. exoleta, Heliothis Ononidis (a Noctua intermediate between dipsacea and scutosa, but not yet known as British) and Fidonia ononaria (which appears to be confined to the South of Europe).

Ononis arvensis. Trailing Rest-Harrow.

In May the larvæ of Pterophorus phæodactylus may be found abundantly on this plant.

Ononis spinosa. Spinous Rest-Harrow.

Speyer enumerates as feeding on this species Heliothis marginata, (of which Guenée remarks "not rare, but rather difficult to rear"), Eupithecia centaureata and Pterophorus calodactylus, by which name, I believe, he means our P. acanthodactylus, which has on several occasions been taken rather freely amongst rest-harrow, though I am not aware that the larva has been found on that plant. Gracilaria Ononidis mines the leaves of this plant in April and May, but hitherto it has escaped the researches of all the Micro-Lepidopterists of this country, the perfect insect having only been taken by sweeping.

Medicago falcata. Yellow Sickle Medick.

Speyer mentions as feeding on this, Lasiocampa Trifolii and Euclidia Mi.

Medicago sativa. Lucerne,
Medicago lupulina. Black Medick,
Medicago maculata. Spotted Medick,

Are not known as the food of any special species, but they are all plants deserving of careful observation.

Melilotus. Melilot.

Speyer mentions the following as feeding on this genus of plants: Polyommatus Alexis and P. Argus, Agrotis rectangula (a scarce South European species), Euplexia lucipara (the larva of which is pretty nearly polyphagous), Mamestra suasa, Strenia clathrata, and the Anthrocera Meliloti (which obtains its name from these plants).

Trifolium. Trefoil.

As the Papilionaceous plants are the favourite food of most of the "little blues," as well as of the Anthroceræ, and several feed with avidity on more than one of this tribe of plants, a good deal of repetition must necessarily ensue, and yet we may be far from mentioning *all* the larvæ which feed on any individual plant.

Speyer gives as feeding on this genus, Polyommatus Adonis, Anthrocera Minos, Loniceræ, Filipendulæ (and the non-British Scabiosæ, Meliloti and Peucedani), Dasychira fascelina, Lasiocampa Trifolii, Triphæna orbona, Mamestra Pisi, Acontia solaris (which latter, however, Guenée gives as feeding only on Convolvulus), and Euclidia Mi.

Trifolium pratense. Purple Clover.

Speyer enumerates as feeding on this species, Orthosia litura, Euclidia glyphica, Aspilates palumbaria and Larentia bipunctaria. It is on this plant that I am inclined to suspect the larva of Coleophora Fabriciella feeds, but up till now, neither in spring nor in autumn, neither on the leaves nor on the seeds, have we been able to find any Coleophora larvæ. Gelechia anthyllidella is not uncommon on this plant.

Trifolium medium. Zigzag Clover.

This is one of the plants on which the larva of Lithocolletis Bremiella has been met with in July and September: this brilliant species, almost surpassing in beauty L. lautella, is not yet numbered amongst our British species; the larva mines the under side of the leaf of T. medium, but is more partial to Vicia sepium and V. angustifolia.

Trifolium arvense. Hare's-foot Trefoil.

Cited by Speyer as a food-plant of Leucophasia Sinapis.

Trifolium procumbens. Hop Trefoil.

Probably the plant from which Mr. Gregson bred Coleophora deauratella (Zool. 4030). It is sad that a half-made observation like this should be allowed to relapse into obscurity.

Lotus corniculatus. Bird's-foot Trefoil.

Speyer mentions as feeding on this plant, Leucophasia Sinapis and Thanaos Tages. This plant is rather favored by the larvæ of Tineina, or probably it would be more correct to say that it has undergone more careful scrutiny; Gelechia ligulella feeds between united leaves in May, Gracilaria Kollariella mines the leaves in July, Coleophora discordella feeds on the leaves in autumn and May, and a Nepticula (not yet bred) mines the leaves in July.

H. T. STAINTON.

Mountsfield, Lewisham, July 16, 1855.

Inquiries into the Philosophy of Zoology. By R. KNOX, M.D., &c.

Part I. — *On the Dentition of the Salmonidæ.*

IN the admirable volume of the 'Histoire Naturelle de Poissons,' in which my esteemed friend M. Valenciennes has discussed the natural history of the Salmonidæ, that distinguished naturalist lays down a doctrine that, in respect of the division of the Salmonidæ into genera or subfamilies, the dentition is the only natural-history character to be absolutely depended on, and that, in point of fact, it has never failed in his hands.

To arrive at this conclusion M. Valenciennes has been forced to exclude from all consideration the natural history of the young, alleging, what no doubt is true in a certain sense, that "the naturalist, as a naturalist, is concerned with or interested only in the adult." By this view, however, my friend embarrasses himself, without seeming to be aware of it, with the difficult question of *age*. Anatomists know well that the *adult* condition is not so easily determined even in mammals, and much less in fishes.

In accordance with views and researches conducted in this spirit, my esteemed friend arrives at the conclusion that the Salmonidæ now living on the globe, form three distinct subfamilies or genera to be clearly and always distinguished by their dentition. To these three genera or subfamilies he appropriates the names of, 1st, Salmo, 2nd, Forelle or Fario, and 3rd, Salmo Trutta or Trout, names not new to naturalists, though new, perhaps, in their strict application to the three subfamilies of the Salmonidæ, long known and distinguished in Britain as salmon, salmon or sea trout, and trout. These subfamilies then correspond with the arrangement of many European naturalists who know them by the names of salmon, salmon-trout and trout: the salesman, on the other hand, speaks of the Salmonidæ as of two kinds only, — with him what is not salmon is trout,—regardless of affiliations with species higher or lower in the scale, he looks only to the market-value of the fish.

To understand the question at issue between M. Valenciennes and myself, I may first remark that the text of my friend is not clear; the engravings inaccurate and unworthy the high character of the work. It is difficult, as I have experienced, to get artists to copy exactly what is placed before them. The errors in the engravings alluded to must be ascribed to the artists employed; the obscurity in the text M. Valenciennes, no doubt, will himself explain.* Proceeding on principles directly opposed to those of M. Valenciennes, I select, as the starting-point of the inquiry, the dentition of the young of the Salmonidæ; one of the objects held in view being to ascertain whether it be correct to say, in all cases, that "the adult salmon is to be characterized by the persistence of certain vomerine teeth only; the forelle by the presence of others superadded to those of the salmon; the Salmo Trutta by the presence of a dentition wholly distinct from both." The whole of my researches are opposed to this view, which, although seemingly practical, is really not so. It may further facilitate the clear apprehension of the object and results of these inquiries, and their bearing on some important points in the Philosophy of Zoology, if I, in the first place, lay before my readers the dental formula arrived at by M. Valenciennes and subsequently the results of the inquiries I have made into this matter, from which I think it will be manifest to the scientific naturalist that the natural-history arrangement of the Salmonidæ adopted by M. Valenciennes is inadmissible.

1st. The true salmon, observes this distinguished naturalist, is characterized by the presence of certain teeth, placed transversely on the fore part (*chevron*) of the vomer, the rest of the bone being edentulous.

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* Whilst occupied with the correction of the proofs of this memoir, I have just been informed of the death of my most amiable and esteemed friend.

2nd. The forelle or Salmo Fario of all countries and localities may at once be recognized and arranged by the presence of transverse teeth on the chevron of the vomer, and by a single row of teeth extending backwards along the body of the vomer, mesially.

3rd. The trout of all localities is known by a double row of teeth on the body of the vomer, the transverse teeth on the chevron or fore part of the bone being absent or but little distinct (*peu distincte*).

This arrangement is so simple, so clear, so seemingly practical, so easily understood, that one feels a reluctance to disturb it: it reminds me of the arrangement of serpents by their dentition, prior to the extension of the inquiry into the Indian species and those of the Japan seas; like it, the formula applied so well to certain genera of Europe and perhaps of Africa that it was the most natural thing in the world to believe it universally true; but it failed in presence of a more extended inquiry, as the natural-history arrangement of M. Valenciennes, in respect of the Salmonidæ, will be found to do.

I. Select a salmon of such a size, say 30lbs. weight, as to leave no reasonable question of its adult condition, and the dentition will, generally, be as follows:—

Upper jaw.—	Maxillary and intermaxillary teeth.	35 + 35	=	70
	Palatal teeth.	17 + 15	=	32
	Vomerine (called by some middle palatal) on the chevron 4; on the body, mesially and behind the others, 1 or 2.			6

Now these teeth of the vomer vary much, even in the adult, for sometimes there are none on the body of the vomer, and the transverse may be five in number or reduced to one or two.

In the lower jaw and on the tongue there are,

1st. Mandibular teeth.	18 + 18	=	36
2nd. Lingual teeth.	5 + 5	=	10

As the teeth of fishes, like those of serpents, are constantly being shed and replaced by others, the number of *fixed teeth* becomes unimportant as a natural-history character. Not so the number of mucous cavities destined to receive the teeth; these, no doubt, are constant and determined from the first. I reckon the dentition, therefore, by the number of these mucous cavities destined to receive the teeth, and not by the number of teeth actually present. So long as these narrow mucous cavities are present, teeth either forming or fixed will be found in connexion with them: their absence implies that the dentition has been exhausted, and that the bone now edentulous will carry no more.

Now, examine the mouth of a true salmon of some 4 or 5 ℔s. weight, and, in addition to the transverse teeth on the *chevron*, you will find a single undulating and somewhat irregular row of teeth extending backwards on the body of the vomer, varying in number, but always present. Were this specimen to be classed by the method of M. Valenciennes, it would be called a Forelle, Fario or sea trout, but we know it to be a pure salmon, though with the dentition of the Forelle. M. Valenciennes would no doubt say, "my formula applies only to the adult salmon, and this is evidently not an adult." I admit the force of the objection, so far as it goes, and shall proceed with my inquiry, at the same time remarking that the natural-history character, which not merely fails in recognising a salmon of 4 ℔s. weight to be a salmon, but which, if attended to, would lead the naturalist to an entirely false view, cannot be viewed as one of any value.

Now, look into the mouth of a salmon about a foot in length, and the dentition of the vomer will be found to consist of, 1st, transverse teeth anteriorly on the chevron; 2nd, posterior vomerine teeth consisting of a double undulating row, as in the common river trout.

Lastly, as regards the true salmon, look into the mouth of a salmon smolt a few inches in length, and the dentition will be found such as I have just described it to be.

Thus, the dentition of the salmon, from the smolt to the adult, passes through a series of metamorphoses, representing the adult dentition of all the species of the Salmonidæ I have yet examined. The edentulatory process then, in the salmon, is not an accidental chapter in its history, but a philosophical reading of its affiliations with all the salmon kind.

II. The practical history of the dentition of the Forelle or Fario, the sea trout of British naturalists, is the same as in the salmon. As a smolt, it resembles in its dentition, with all other species of the Salmonidæ, the common trout. At a pound weight it still retains a double alternating undulating row of teeth on the body of the vomer, together with a distinct cluster on the fore part of the bone. At 3 or 4 lbs. weight the mesial row of the vomerine teeth from being double has become single; when larger or heavier, and presumed to be older, these mesial teeth begin to fall out and are not replaced, the teeth on the chevron remaining to the last. In the sea trout, as in the salmon, the progress of edentulation is from behind forwards, and the process goes on until they are not unfrequently reduced tc two or three, at which point, in respect of its dentition, the true salmon and the Fario are identical, or nearly so.

Thus the dentar formula of the French naturalist is again at fault. By it alone, the true salmon, from the smolt upwards to the fish of 2 lbs. weight could be distinguished neither from the common trout nor sea trout or forelle; and now we find, that by it alone, the full-grown forelle can scarcely, if at all, be distinguished from the true salmon.

III. Let us now apply the formula to the fish called the Salmo Trutta or common trout, lacustrine and riverine. In the young of all species the dentition is the same. The vomer carries the two kinds of teeth, the transverse and the longitudinal, perfectly distinct. The posterior are arranged in a double interrupted or undulating row, and extend well back on the body of the vomer; the group of teeth in front, already spoken of as the transverse teeth or those of the chevron, are well marked, and quite identical with the species of all the genera of the Salmonidæ. In certain large lacustrine trout I have examined, weighing from 6 to 12, and in one of 20 lbs, there was a double row of teeth on the body of the vomer, but the anterior group on the chevron had disappeared. Thus the law of edentulation in these lacustrine trout was the reverse of that subsisting in the true salmon and Fario, but I do not mean this to be applied to all the species of lacustrine trout, for I have not examined all; and the longer I live and the more extended my inquiries are, the more deeply am I convinced of the error of applying natural-history views derived from the examination of species and genera of one continent or of one country to those of another. Nature admits not of the restrictions laid down by naturalists; an European fact is not an African or Asiatic one,—still less is it kosmic.

As to the river trout I have examined, from a few ounces to 10 or 12 lbs. weight, I have found the law of their dentition to be a double row of teeth upon the body of the vomer, and, in addition, a group of transverse teeth on the fore part of the same bone, perfectly distinct. That there may be riverine species which lose the anterior group, and others which retain these but lose the posterior or mesial, I will neither affirm nor deny; I speak only of what I have seen. For reasons to be afterwards stated, I am inclined to think that this will be found to be the case.

IV. I shall now place before my readers, as briefly as I can, the result of multiplied researches into this subject. As a transcendental anatomist, I naturally commence with the dentition of the young; in its history we have the key to the numerous exceptions, rendering M. Valenciennes' law inapplicable, and to the anomalies and embarrassments of naturalists and others. If we commence the inquiry into the history of the dentition of the Salmonidæ at a stage of their growth when the size of the teeth admits of ready and sure inspection,—let us say in a fish from 2½ to 4 inches in length, we shall find that whatever be the species examined, the dentition is the same. It consists of

Upper jaw.—	Maxillary teeth	19 + 19	=	38
	Intermaxillary do.	9 + 9	=	18
	Palatal	15 + 16	=	31
	Vomerine (anterior group or transverse mesial and posterior in a double row)			16
Lower jaw.—	Mandibular	18 + 18	=	36
Tongue.—	Lingual	5 + 5	=	10

Thus, as regards the dentition, the young of the Salmonidæ is of no species, but a generic animal, whose nearest approach as to type in the adult animal is the common river trout. It possesses all the teeth which any species of the natural family ever has, and more than any adult of any other species, and even in this respect is the perfect animal, *i.e. perfect generically.* By growth, which means merely the metamorphoses or transformations it has to undergo before acquiring its speciality, the generic young of the Salmonidæ simply loses certain teeth, which are not replaced; it does not acquire any new ones not already existing. As the changes are most remarkable in the system of the vomerine teeth, I shall confine my remarks to these.

1st. If the young fish is to grow up a river trout simply, it retains, as seems to me, in some species at least, all its vomerine teeth to its adult condition. I have examined large river trout of England, and such I have found to be the arrangement: the transverse or anterior cluster of vomerine teeth, which M. Valenciennes assumes to be absent in the adult of all trout, are quite as distinct and as large as those on the body of the vomer. Here is the dentition as regards the vomerine teeth of a Kennett trout (Hampshire) caught in the waters of Popham, weighing 9¾ lbs.; the anterior cluster of vomerine teeth are large and distinct; they are five in number; they are followed by a double row of teeth on the body of the vomer, also quite distinct;

these are ten or twelve in number. I have also examined a large Thames trout, weighing 5½ lbs.; it has a double row of teeth on the body of the vomer, and a group of perfectly distinct teeth on the chevron of the vomer. There is the skeleton of a very large river trout in the College of Surgeons, in London; the specimen is not favorably placed for the examination of this question, but so far as I can observe, the teeth are arranged as in the Kennett trout: thus, contrary to M. Valenciennes' view, these species of trout are not characterized by the absence of the anterior group, but, by the presence of a double row on the body of the vomer, which I have found to apply to all trout; all are characterized by a double row of teeth on the body of the vomer, but as regards the transverse or anterior teeth, some lose them and some do not; the river trout seem to retain them to the last, and M. Valenciennes admits that they are present in the beautiful trout of the Moselle, that species which he assumes as the type of his genus Salmo Trutta. Here is the description of the dentition of the trout of the Moselle by M. Valenciennes himself: "Il en existe un seul rang, sur chaque palatin et celles de vomer disposées sur deux rangs, sont divergentes aussi même plus fortes; aussi une petite rang transversale sur le chevron."* The trout of Baillon, which M. Valenciennes at first mistook for a salmon, until put right, as he admits, by the fishermen, has a double row of teeth on the body of the vomer, and a complete set of transverse teeth. Now this determination he arrived at from the examination of a young fish 13½ inches long; but with years, the trout of Baillon may lose some of these teeth and assume a different character; in as far, then, as regards the dentition of a Baillon trout of 13½ inches, the fish might be either a common river trout, a sea trout, or a salmon, for at that age the dentition is nearly identical in all; and thus the subfamily to which the Baillon trout belongs has not been determined by M. Valenciennes, and cannot be by his method in a fish of the size quoted.

On the other hand, in certain large lake trout, reported to me as from Ireland, the anterior cluster of vomerine teeth was absent or had disappeared, there remaining on the body of the vomer a double row of teeth: these trout were of great size: now this is the dentition which corresponds to M. Valenciennes' idea of a real trout, but we have seen that it does not apply to any river trout I have yet examined, nor to those of France, nor even rigorously to the celebrated

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* Page 321, 8vo edition.

Leman trout, which has teeth on the chevron of the vomer. The adult lake trout I speak of were dark spotted trout with pink-coloured flesh. They all had a double row of teeth on the body of the vomer, whilst the anterior group, called transverse and teeth of the chevron by M. Valenciennes, had disappeared. That they were once present no one can now doubt; the law therefore of edentulation (for, in point of fact, it comes to this) in the lake trout of the species I now speak of, is to lose the anterior group of the vomerine teeth and to retain the double row on the body of the vomer to the last.

On the other hand, in a 4 lbs trout of Loch Leven, the largest of that peculiar species I have yet examined, the anterior clustered vomerine teeth were present, whilst those on the body were assuming the form of a single undulating row, which possibly in time they would have become.

Lastly, M. Valenciennes admits, that in the mouth of the trout of the Moselle, which he views as the type of the order, the clustered anterior teeth are distinct as well as the double row on the body of the vomer, thus excluding the species forming the type of the order from the law he intends shall apply to all.

Thus, the law of M. Valenciennes does not apply to the trout of British rivers nor to those of certain lakes, whilst it expresses the dentition of others. It is not then a safe guide for the determination of the subfamily, Salmo Trutta. Let us now test its accuracy in respect of the remaining subfamilies, the forelle or salmon trout and the true salmon.

If we trace the young of the forelle in its progress towards the adult fish, we shall find that up to a certain weight it retains its original generic dentition, that is, it resembles strictly that of all the salmon kind. At this stage of its growth or metamorphosis it could not be distinguished by the dentition alone from the Salmo Trutta or from the true salmon of the same size: yet neither the salesman, nor the naturalist, nor even the angler, lowest in the scale of observers, experiences any difficulty in deciding on the nature of the fish before him. They do not look at the teeth; they have other much surer characteristics, even at that age. Tracing the forelle until it attains a considerable size, we find at last that the body of the vomer presents a single row of teeth; but the same edentulation has happened to the salmon of the same size: in both, this single row is finally reduced to one or two teeth, and may in both ultimately disappear; even the clustered teeth are ultimately reduced in the very large salmon and sea trout to two or three.

The law of edentulation, then, in the Salmonidæ is curious and interesting, the result seemingly of generic and specific influences. Certain of these difficulties are removed by tracing its history from the young, *i.e.* the generic fish, onwards. In it we find a type including all; it alone is perfect, the species being characterized by a loss of parts and not by any superadded organs. To this conclusion I had long ago arrived by other routes. What is true of the dentition we shall find to hold good in respect of some other characteristics of the generic animal, and to these, after a few additional remarks, I next proceed.

Up to the length of 13 or 14 inches, the dentition in all the subfamilies is nearly the same; at 2 lbs weight the dentition of the forelle and salmon is identical. They are both beginning to lose the teeth of the body of the vomer, and often show a single instead of a double row. At 6, 8, 10 or 20 lbs weight, both have lost the greater number of the teeth on the body of the vomer, but still retain those on the chevron. There may be certain species of the forelle or salmon trout which retain, to a large size, a single row of teeth on the body of the vomer, but I have not met with them.

Throughout the preceding observations I have confined my remarks, with but few exceptions, to species and subfamilies I have myself examined and can command; not that I distrust the observations of others, for what observations can, for example, be more fully depended on than the valuable contributions to Science of my most esteemed friend, Sir John Richardson. If a reference be made to his admirable work, the 'Fauna Boreali-Americana,' it will there be found, that the formula in use by M. Valenciennes, will not, cannot be applied with any success to the vast number of species of the Salmonidæ which people the seas and rivers of the great Continent of America. The Mackenzie River salmon, for example, must be rejected altogether from the natural family of the Salmonidæ, if the dentition alone be regarded, for it has the teeth *en velours,* or like the pile of velvet in narrow bands, and the upper maxillary bones carry none. The Salmo Rossii has thirty teeth on the tongue. Is Scouler's salmon (*Salmo Scouleri*) a salmon, a Fario, or a trout? The palatine and vomerine teeth are implanted in double rows, and there are none on the chevron of the vomer: here is a true salmon, for such I esteem it to be, with a dentition wholly peculiar. The great lake trout of North America has a cluster of teeth on the anterior part of the vomer, and a double row behind, and herein is directly contrasted with the British lake species. In the common trout of New York there is a triangular cluster of about ten teeth on the anterior part of the vomer: no mention is made of any posterior rows. Such exceptions could be much multiplied; they are sufficient to prove that a dentar formula applicable to the adult Salmonidæ of all species has not yet been found.

Section II.

As it is by the exterior and not by the interior, that Nature chiefly specializes all animals, bestowing on them those outward forms, colouring and proportions, by which they are known to men and animals,—enabling man to distinguish at a glance the lion from the tiger, the zebra and ass from the horse and mule, the dog from the fox and wolf, which the interior, though examined by the profoundest anatomist that ever lived, scarcely enables him to do,—so I return to the exterior of the Salmonidæ to look for other proofs of the existence of the law I now seek to establish; the law by which I endeavour to give the genus or natural family a real existence; to reduce it to materiality; to include it within the range of legitimate science, and to submit it to intuitive or direct inspection; to prove, in fact, the young to be of no species, a generic being, invisible as such to the bulk of mankind, but real, tangible and visible to the scientific.

Coloration of the Salmonidæ.

The system of coloration of the Salmonidæ is either specific or generic. When the individual is in prime condition, perfectly developed, pure in breed, and adult, in as far as we can well determine, the coloration may then be considered specific, may be assumed as unalterable, in a certain sense, and characteristic. Viewed in this way, the coloration, 1st, of the true salmon may be briefly defined as silvery scaly, with a few dark or purple spots above the lateral line; 2nd, of the forelle, less silvery, with numerous dark spots above and below the lateral line; 3rd, of the lake trout, dark or purplish spots, more or less numerous, above and below the lateral line, and of the river trout, red spots more or less numerous above and below the lateral line. Lastly, certain river trout retain throughout life transverse bars composed of numerous minute dark spots; these I shall call parr-markings, as they are most distinct in the little fish which in France is called *tacon*, in Scotland parr, in England fingerling, a fish of doubtful character, and whose real nature has not yet been clearly determined. I do not mean that these arrangements include all the species of the three subfamilies of the Salmonidæ; but the arrangement is of unobjectionable accuracy, in so far as it goes. There are many foreign species, no doubt, filling up all the gaps in each subfamily, but these have not been, as yet, sufficiently described.

Such is the specific coloration of the three great subfamilies generally. What is the generic coloration, that, namely, which includes all these? What is the coloration of the young, the generic type of the entire family? To describe it, we have only to examine the young of any of the species of any of the subfamilies, and we shall find that its coloration embraces all,—red spots, dark spots, of various hues, parr-markings, silvery scales. The generic animal then is perfect, and represents Nature's scheme; as it grows towards maturity it gradually lays aside its generic characters, retaining the special; if it is to become a river trout it retains the red spots, losing the others; one species, the parr trout, retains, with the red spots, the parr-markings; if a lake trout it loses the red spots, and retains the purplish and dark ones; if a sea trout or forelle it retains the dark spots only; if a salmon it loses all, saving a very few; the fewer it has, the more is it considered as of pure breed. A salmon showing five or six dark spots below the lateral line is looked on with suspicion by the salesmen, as if it had something of the forelle or trout about it; when puzzled, he turns the doubtful fish over and looks at it from several points of view; he is at that moment endeavouring to elicit a correct idea of its proportions, to which he appeals in the last instance. Scientific men would do well occasionally to observe the interested, for wherever self-interest is concerned the senses become exceedingly acute and the powers of observation infinitely refined. As nothing, I imagine, of the nature of gold could escape the eye of the experienced gold-seeker, so nothing that is eatable escapes the notice of the savage Bosjeman: poisonous serpents they distinguish from the innocuous at a glance, and from a drove of ten thousand oxen they will select and claim for their master, after a year's absence, a single animal of a team they once knew. The salesman, then, seldom errs in his discrimination of the fish submitted to his inspection: he knows nothing of Science, but trusts to his tact and instincts. It is the same with woman; she never bewilders herself with Science, but, trusting to acute observation, she proves generally the best of practical naturalists. That the system of coloration in the Salmonidæ cannot always be depended on in characterizing the species may be admitted without under-rating its value. Human observation is not extremely refined; it is, in fact, extremely imperfect; besides, in the case of the Salmonidæ, the generic colouring is apt to reappear, though imperfectly, even in the adult: hence a fertile source, no doubt, of error. For my own part, I believe the system of coloration of the Salmonidæ to obey fixed laws, and to be constant and regular, the class being free from any influence which obviously affects the colour, namely, domesticity.

Section III.—*The Proportions of the Salmonidæ, as compared with each other and with the Generic Animal.*

The adult well-formed individual of every species of animal has its due proportions characteristic of its nature; with these its movements or style of motion is connected. By these movements it may be recognized by man and other animals when alive; when dead or at rest, its proportions indicate its nature. The distinction extends not unfrequently to sex, in which case the peculiar proportions are said to be sexual. In wild animals these proportions are remarkably constant, suffering indeed but little change or variety, as in the case of the coloration; it is amongst those animals whose nature permits of domestication that we find colour and proportions to undergo changes, which, though limited, are yet remarkable in extent.

Nearly all my early observations, made many years ago, were instituted on the adult specimen, or rather (for it is not so easy to determine what is adult) on individuals which had attained a considerable size. Salmon, sea trout and trout, of various species, were carefully measured and compared with each other, and the results compared, the object being to discover the law of subfamily and species. To these I now add the proportions of the generic animal, as compared with the adult, from which I think it will be manifest that the generic animal has proportions peculiar to itself, yet including the specific, that is, it presents a type out of which all the others may easily be constructed by the comparative enlargement of some measurements and the comparative restriction of others. The tables of these measurements I give at the conclusion of this section; the general results may be stated here.

Tabular view of the relative proportions—

1. Of the head;
2. Of the segment of the body anterior to the anal fin to the length;
3. Of the segment of the body beyond the anal fin to the length—

in the

Smolt.	*Estuary Trout.*	*Leven Trout.*	*Tweed Trout.*
1.	1.	1.	1.
¼ in. nearly.	⅕ in. nearly.	⅕ in.	¼ in.
2.	2.	2.	2.
·571.	·678.	·664.	·664.
3.	3.	3.	3.
15 to 35 or 2·33.	33 to 101 or 3·06.	34 to 100 or 2·94.	32 to 95 or 3·06.

The three great functions of respiration, locomotion and prehension, as represented by the jaws, teeth and fins, may be held, as compared with the general bulk of the body, to offer natural-history characters more or less indicative of the natural state of the individual, and of consequence of the species and subfamily to which it may belong: accordingly it appeared on measurement, that, in respect of the fins generally, the true salmon was much more delicately organised than the salmon trout, a coarser and no doubt a more rapacious fish, and that assuming the head (the gill covers and branchial orifices included) as a tolerably correct measure of the comparative strength of the gills and jaws, or, in other words, of the organs of respiration and prehension, the salmon trout, or forelle, uniformly exceeded the salmon in all such measurements. This law of proportions I found to hold good in all the species of the Salmo Trutta I have yet examined; the coarse fish presenting enlarged proportions of the organs I have just spoken of, as compared with the more delicate species; the common river trout, for example, of the brooks and rivers of Scotland, compared with the estuary trout, and more especially with the delicate char-trout of Loch Leven. The very young of the salmon kind, in its proportions, approaches more nearly the type of the common river trout than any other: as it grows these proportions alter, but even when of 4 or 5 inches in length its proportions are still peculiar, resembling more in their character the type of the river trout than that of the salmon, to which the specimen we know belongs. The measurements were made on the young of salmon from the Tay, the Shin and the Annan.

Thus the young animal, at a certain stage of its growth, is the type not of the species to which it belongs by hereditary descent, but represents a generic type, transcendental, and requiring for its full development or embodiment in all its material, that is, specific forms, countless millions of years; for as the young, that is, the generic animal, includes many species, perhaps all which the natural family can assume in time and space, so as species die out, others appear, new to the world as species, but not generically. The *ossemens fossiles* belong to species clearly distinct from those that now live; their generic resemblance is undeniable. Species perish, but not genera, and thus the past, present and future, form but one. Species are not convertible into each other by any influences at present known to man: that these species follow each other, agreeably to certain laws, may be admitted, but that it is in the direction of a supposed perfectibility I do not believe, nor ever did. Time, which means plan and circumstances, which mean the geological changes on the earth, are, no doubt, the producing causes of species. Hence, the generic unity of every natural family, and the appearance from time to time of individuals, not resembling the species from which they spring, but others of the same natural family.

As regards the dentition, then, of the Salmonidæ, the young are of no species; on the contrary, they are transcendentally generic, that is, each individual, no matter how descended hereditarily, displays all the characters of all the species and subfamilies of that natural family to which it belongs: as it contains within it the possible of all the species, it seems reasonable to believe, that its development into any peculiar species must be dependent on physical causes at least, which must have a direct relation to the existing order of things. Should a species become extinct, another appears. This implies no new formation or creation, nor after all any real extinction, for the characters of the new species (new to man, who naturally looks only to the adult) and those of the extinct are still included in the young of every species which yet lives, or has lived. What has become extinct, may even reappear; but should the natural family perish all the species cease with it.

Domesticity plays a limited part in the production of varied forms, but these forms do not constitute species: some species are more influenced by domesticity than others; man very little, if at all. It is the same as regards the laws of coloration and proportions: the generic animal includes the types of all.

I have sometimes thought that this law of natural family and of propagation of a generic animal not at first specific may play a part in some phenomena at present inexplicable. For example: all that is as yet known respecting the river fish called parr was known to Willoughby; even the extraordinary fact that in the female parr the ovaria remain stationary, whilst in the males the milts at certain times become excessively developed. This antagonism in the character of the young has no counterpart, in so far as I know, in natural history. But a still more extraordinary fact, though not so well determined as the preceding, was also known to Willoughby. With this milt of the male parr the ova of a salmon 40 lbs. in weight may be fecundated, whilst the parr itself does not weigh more than 3 or 4 ounces. Now, there is nothing like this in natural history, and the fact stands alone in singularity. Reflecting on these curious facts in the history of the parr, and on others connected with its natural history, I have sometimes fancied that as the parr is a generic animal apparently, upon whose specific form naturalists are not yet agreed, may it not be, that being the product of a generic animal which has not attained a specific form, it may never attain that condition, but remain in this aborted state, a type merely of the salmon kind. In the case of the parr, if this idea be correct, the female remains barren, the male becomes productive: possibly in the great range of the zoological world there may be instances of the contrary, though unknown to me; or it may happen, as a law of nature, that the generic animal of both sexes may grow up unaltered and be productive, the specific forms not appearing in the existing order of things. These are but speculations it is true, but they are speculations supported by laws which hitherto have been, and still are, but imperfectly understood.

I here subjoin a single remark, lest it be supposed that I believe in the reality of species.

Species are only real in so far as regards man's observing powers: they seem to form no part of Natures scheme or plan, which obviously fills up all gaps, leaving no link deficient in the great chain. A serial unity connects all, the past, the present, and the future. Those who fancy that gaps exist mistake merely a deficiency in their own knowledge for a part of Nature's scheme. The transmutation of one species into another I do not believe in, any more than in the three or four successive creations of Cuvier. Unless we are prepared to adopt the doctrine of chance, there can exist only one creative idea, and consequently one creation. The theological doctrine of Socrates, worked into a system by Philo-Judæus and his followers of "the final cause" school, applies merely to simple mechanical laws of obvious signification and application: it has nothing to do with the great laws of life; the laws of formation and deformation; the laws of unity of the organisation in all that ever lived; the law of serial unity which makes the living and past organic worlds one, and not many.

Nevertheless, to man, species is everything in a practical sense; for, although specific character and structure explain but little in the philosophy of zoology, specialities are the first steps which lead to more important inquiries: without this step philosophic zoology, geology, palæontology, could not be said to exist: hence the intrinsic and enduring value of the labours of the immortal Cuvier.

R. Knox.

Meissen House, Upper Clapton,
June, 1855.

On the Growth of the Salmon, from the Egg to the Adult.

By R. Knox, M.D., F.R.S.E., &c.

All who have angled in such rivers as the Tweed, frequented by salmon, sea trout and river trout, must soon, if they observe at all, have become acquainted with the following facts or appearances:—

1. That river or common trout, whether large or small, may be readily enough distinguished from every other kind of fish caught in the river; occasionally, though rarely, the young trout may be confounded, when about the length of the little finger, with a small fish called the parr, to whose history I shall presently advert, but, in the fresh specimen, and with a good sight, the young trout may always be distinguished from the parr.

2. That these small fish, called parr, are to be found in the rivers frequented by salmon or salmon trout, from the sources to their embouchures, and in such rivers only. But the converse of this is doubted; first, by Mr. Young, of Invershin, who says that there are rivers frequented by parr, into which neither salmon nor salmon trout have ever penetrated; secondly, although I fished the Tyne, in Scotland, a great many times, and had it fished for me by skilful anglers, who knew the river well, I never could find a parr; thirdly, I was present at the fishing of a stream on the East coast of England (North Riding of Yorkshire), on the estate of Mr. Wharton, near Guisborough: the stream was fished with a net (which took everything), from a mill-dam insurmountable for salmon to the sea, yet no parrs were found: nothing, indeed, was taken but—1st, sea-trout of various sizes; 2nd, smolts covered with scales, on their way to the sea; and 3rdly,

a few common trout: on every hypothesis, save one, the absence of the parr in these and the adjoining streams is inexplicable: the fishing took place in May; the sea trout and smolts were descending to the sea: the net took everything to the minnow, yet no parrs were to be found: on one hypothesis alone is this explicable, namely, that the young of the sea trout, hatched from the ova deposited in November of the preceding year, had all become smolts, and were proceeding to the sea. If the age of these smolts had been two years or even one year, the young fish, in their generic or parr dress, must have been found in the streams and pools: nothing of the sort occurred: had the smolts, then and there found, being the females of one year, the males of the same age, but less in size, not as yet changed into smolts, must have been discovered in the net: in a fishing of some miles nothing of the kind appeared.

3. That these fish, called parr, are male and female; that in the female the roe remains always at its minimum; in the male, on the contrary, the milt enlarges remarkably during the autumn and winter months, and not infrequently is found enlarged at all times of the year.

4. That, in addition to river trout of various sizes, and of parr, which never exceed eight or nine inches in length, there appear suddenly as it were, in the streams, in May, thousands of a small fish (the smolt) covered with silvery scales, which fish is presumed to be, and has been proved to be, the young of the salmon and sea trout. It was first remarked by Mr. Hutchinson, of Carlisle, in 1782, and subsequently by all who observed what happened to the smolt when kept for some time and roughly handled, that the scales being rubbed off, the smolt assumes the appearance of a parr; but Mr. Hutchinson did not think that this proved the smolt and parr identical. What is the age of these fish—of the May smolts? The whole question of the protection of the salmon is wrapped up in this question. The question of its identity with the parr is a distinct question; the presence of the parr-markings to be discovered under the scales proves nothing specifically, since these are generic characters common to the whole natural family of the Salmonidæ at a certain period of their growth or development to trout and salmon of every kind.

5. It was asserted by Willoughby (1686), and the assertion has not been refuted, that with the developed milt of a male parr, 6 or 7 inches in length, the ova of a full-grown salmon may be fecundated. If we adopt the theory, that under every circumstance the parr is simply a young salmon or salmon trout, as the case may be, the astounding physiological fact first announced by Willoughby still

remains unexplained, and without a counterpart in zoology, namely, that the male salmon of five or six months age, according to the Invershin hypothesis, and of seventeen or eighteen months age, agreeable to the Drumlanrig experimenter, should already have arrived at the adult condition in respect of the ability of reproducing his kind; the female in the meantime continuing, as regards the ovaria, at the minimum of development; and, as if to add to the complexity of the enigma, we are now further asked by these experimenters to believe, that the female, in whom the ovaria do not alter, grows faster than the male by a whole year, the generative organs and the general growth of the body being in an inverse ratio to each other.

6. The May smolts, covered with scales, collect into flocks or groups, and descend the rivers to the ocean; parrs never do. In the smolt which descends to the ocean in May to seek a habitat still unknown, the ovaria and milt are uniformly at their minimum. His food in the ocean was unknown until I demonstrated it to be the eggs of the Echinodermata. The smolt which descends to the ocean in May, 5 or 6 ounces in weight, returns in July, August and September a grilse or salmon of as many pounds. If permitted, he returns to the ocean next spring; he again makes for the rivers a grown salmon in the autumn of the same year, varying from 12 to 20 lbs. weight. His subsequent history is not well known.

Lastly: Whilst in the fresh waters the grown salmon does not feed, but loses condition to a great extent: thus a return to the ocean is essential to his existence. Whilst a smolt he lived and throve on the common food of trout; he acquires the silvery scales in May, being then 7 or 8 inches in length; he seeks the ocean, impelled by an instinct seemingly as strong as that which induces the grown salmon to rush up the rivers at the approach of winter.

The observations just made are generally admitted to be facts: the more curious, indeed all of any moment, were known to Willoughby, Hutchinson and others; but they do not solve the difficulties connected with the subject, the first of which is—What is the age of the May smolt?

What is the age of the May Smolt?

The opinion which has prevailed, in Annandale, time out of mind, is, that as the parr is the young of the salmon, so the May smolt must be one or two years old; some thought more. The practical fishermen of the Tweed thought otherwise; they disbelieved the parr to be the young of the salmon, and thought that the May smolt was the product of ova deposited under the gravel in October, November and December of the previous year. To bring the question of age to an issue there are obviously two ways: the first is to observe the progress of the ova surrounded by the natural influences, and undisturbed; the second is to watch the development of the ova placed in artificial circumstances. I naturally adopted the first, and for this simple reason, that the salmon being an animal *feræ naturæ*, or of the *wilde;* it would, at all times, be difficult to say how far an artificial locality might affect it. The result of my early observations have been stated briefly, and in much clearer terms by Sir John Richardson, in his admirable 'Fauna Boreali-Americana,' than by myself. I shall here quote from his work, premising that I had already carefully observed the development of the ova of the salmon deposited in the bed of the Whitadder, on the 2nd November, 1832; that on the 25th February I found the ova under the gravel seemingly unchanged; that on the 23rd March changes were visible, some of the young fry having burst their coverings, and were lying embedded in the gravel. On the 1st of April most of the fry had quitted their gravelly bed, and on the 19th May the river abounded with smolts (some 7 or 8 inches in length) of various sizes, all covered with scales. We now learned that smolts had been taken on the 5th May in the same streams, which I considered as the young of an earlier hatching, and as on a subsequent occasion I found ova unchanged on the 10th April, and on the 17th April fry lying embedded in the gravel, I inferred that the time of hatching varied according to circumstances easily understood. Twenty-two smolts were taken from the river, and examined with the greatest care; they were male and female, in tolerably equal numbers; the male could often be recognised from the female by the enlargement of the extremity of the lower jaw. It is right to observe, that for two or three years the parr had disappeared from the Whitadder. To return to the remarks made on this subject by Sir John Richardson, extracted from his admirable work on the American Fauna:—

"Dr. Knox, in the appendix to the very able paper from which the foregoing passages are abridged, remarks, that there are two circumstances which persons* of sound judgment and great experience with regard to the salmon question still think undecided, or at least demanding a more extended proof. The first is a series of experiments to determine the growth of the salmon fry from the state of the egg to its attaining the length of 6, 7, 8 or 9 inches, before which it is seldom seen by the angler, and after which it ceases to be found in fresh-water rivers. Secondly, proof that the fish we call salmon fry (smolts), taken in salmon rivers by anglers during the months of April and May, do really proceed to the ocean, and return after a period to the rivers as grilse, salmon trout, and salmon. The facts ascertained by Dr. Knox, in conjunction with the previous observations of others who have attended to the subject, go towards the answer of the first question, whilst the experiments made in Sutherlandshire, on the Laxford and Divard may be considered as a reply to the second. Fry marked in April returned as grilse on the 25th June."

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* I alluded to Mr. R. Buist, of Perth.

Soon after these observations had been made and submitted to the Royal Society of Edinburgh, others entered on the field, and the Duke of Buccleugh must have taken some interest in the matter, since he permitted one of his game-keepers, a Mr. Shaw, to experiment on the ova of the salmon, and on what he called the parr. The ideas of this person respecting the parr have no foundation whatever either in observation or experiment; the experiments he made led to what is called the two-years' theory of the May smolt. By confining the young of the salmon in ponds and boxes, and placing them under artificial circumstances, he contrived to retard the growth of the fry to the extent specified: thus he first misled himself, and then others.

When I first heard of the two years' theory of the age of the May smolt, my remark was this—"Wait a little, and another experimenter, proceeding on the same principles or want of principle, will prove to you that three years is the age; and after a little while another of the same class will show you that one year is the true period." The prediction was verified to the letter. Mr. Hannay, of Kircudbright,* showed by experiment that the smolt is a three years' old fish; Mr. Young, of Invershin, by the same method, proves one year to be the true age, and the experiment repeated at this moment by my esteemed friend Dr. Esdaile, of Perth, on ova reared in ponds adjoining the Tay, has brought to a sudden close, and for ever, the two-year' old theory, a delusion of the plainest character, but yet sufficient to mislead many naturalists. Scientific continental naturalists, finding persons engaging in these controversies who are not scientific men in any sense of the term, stand aloof.

Whilst I now write my friend Dr. Esdaile, to whom the public is already deeply indebted for services rendered humanity in India, and who I am proud to say was at one time my student, informs me by letter, that a new theory of the age of the May smolt has been proposed, intended to include the history of the parr and all its difficulties: it is this; "the silvery May smolt fully developed as a smolt, and actually proceeding with or without the kelts, or spawned fish of last autumn, is a female of one year's growth; the males are there still in the form of parrs; their growth is slower; they remain in the waters another year, forming the autumn and winter parr, and descending next May with their sisters of one year's growth." I do not recollect a single observation directly in favour of this view, which still leaves all that is extraordinary in the history of the parr unexplained. The smolts which descend the rivers in May are of all sizes, from 3 inches or less to 7, 8 and 9 inches; the males supposed to be left are at least as large. These smolts are of both sexes, and such will be found to be the case with those leaving the ponds on the Tay. But if this be true, (which I doubt not), what becomes of the theory? The following are a few of the direct observations bearing on this question which I find in a little work I published lately,* but many more could be added to this had I leisure to examine my journals.

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* See this gentleman's letter, published by me in the work already quoted; the original is now before me.

At my request, Mr. Harkness, of Lochmaben, fished the Æ, an Annandale river, for me in December, and caught with a bait (small red worms) twenty-four parr, which he transmitted to me at the time in Edinburgh. Of these parr fourteen were female and ten male. The largest parr measured 7 inches, the smallest 3 inches; the average was 5½ inches. The female parr were as large as the May smolts. Why had they not left in the preceding May? In the females the ovaria were as usual at their minimum: in some of the males the milts were of considerable size, in others not developed: they had been feeding on insects. Now, if these parr were young salmon, why the development of the milt in the male? And if the females belonged to the class which was to descend next May, and the males only after another year, how comes it that no well-marked distinction can be established in respect of size? Of the hundreds of May smolts I have examined, I have never found the roe or milts altered in the slightest degree; they were uniformly at their minimum, nor could I ever discover any traces indicative of a fact which ought to have occurred if the winter male parr, with the milt developed, grew into a salmon, namely, appearances indicating that the milt had been developed the preceding winter.

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* 'Fish and Fishings in the Lone Glens of Scotland. Routledge, London.'

On the 22nd July, 1833, six parr were caught with the artificial fly at Romaro bridge on the Lyne, a branch of the Tweed. They were of the usual size, averaging probably 5 inches: all were males, with the milts large, and 2¼ inches in length. Do we usually find salmon with the milts large in July? And if these parr become smolts next May, what in the meantime becomes of the enormously enlarged milts?

On the 3rd September, of thirteen parr caught in the Tweed, between the Bield and Polmudie, there were only two females, and such observations, if repeated and supported by extensive evidence, might lead to important results. In the mean time, it is remarked in my journal, that of these eleven males some were 8½ inches in length, others only 4 or 5 inches; in the larger the milts were enormously enlarged. Now, what became of these males, which in September were as large as the largest May smolts? Did they cease to grow until the arrival of May? What became of the milts? And if such a premature development of the male takes place without a cause and without an object, how comes it that no May smolt ever shows traces of these organs having been once developed?

In conclusion, it is to be regretted that experiments which might have formed valuable acquisitions to science have been so conducted as to be repudiated by most scientific men. Profoundly ignorant of the basis of all zoological science, the observers could not be trusted. Those being now conducted near Perth are in quite different hands, and will, no doubt, lead to important results. The question of a disproportion of males to females, as regards the autumn and winter parr, did not escape my notice, as may be seen by reference to page 93 of the work so often referred to in this brief notice; at page 95 will be found a minute account of the experiments on the Dee, proving the three-year old theory. With a little more confinement and restraint, the period of development of the smolt might perhaps have been extended to four years;* the two and three-year theories have now been disposed of by my friend Dr. Esdaile, but the one year view has still to be proved, and this can never be satisfactorily done by breeding in artificial waters.

R. KNOX.

Miessen House, Upper Clapton,
June, 1855.

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* Mr. Newman, editor of the 'Zoologist,' and a distinguished naturalist, informs me that you may keep tadpoles as tadpoles as long as you like, merely by restraining their development.

PROCEEDINGS OF SOCIETIES.

ENTOMOLOGICAL SOCIETY.

July 2, 1855.—JOHN CURTIS, Esq., President, in the chair.

Donations.

The following donations were announced, and thanks ordered to be given to the donors:—'Proceedings of the Royal Society,' Vol. vii., No. 13; by the Society. 'The Literary Gazette' for June; by the Editor. 'The Journal of the Society of Arts' for June; by the Society. 'The Zoologist' for July; by the Editor. 'Revue et Magasin de Zoologie,' 1855, No. 5; by the Editor, M. Guèrin Méneville. 'Monograph on the British Species of Phalangidæ or Harvest-men'; by R. H. Meade, F.R.C.S.; by the Author. 'Saussure's Monographie des Guêpes Sociales', Cahir, No. 7; by the Author. A specimen of the mole cricket (*Gryllotalpa vulgaris*); by Mr. J. P. Edwards, of Lyndhurst, Hants.

Election of Members.

John Walter Lea, Esq., of Ramsgate, and Alexander Fry, Esq., of Montague Square, were balloted for, and elected members of the Society.

Exhibitions.

Mr. Meade returned and exhibited the collection of British Arachnida, preserved in glass tubes, formerly presented by him to the Society, and which had recently been forwarded to him for the purpose of replenishing the spirit in the tubes: he had also considerably increased the number of species in the collection, which now numbers ninety-four true spiders and thirteen Phalangidæ. Mr. Meade stated that he now employed as a substitute for spirit, a saline solution composed of equal weights of water and sulphate of magnesia, with the addition of a small quantity of alcohol and sulphuric acid; this does not injure the colours of spiders, as spirit almost invariably does.

Mr. Foxcroft sent for exhibition a small box of Lepidoptera, recently taken in Perthshire; it also contained the silken galleries formed in ants' nests by the larvæ of Tinea ochraceella, *Teng*.

Mr. Stevens exhibited a splendid new longicorn beetle from Tana, New Hebrides, for which Mr. Adam White proposed the name of Psalidocoptus scaber.

Mr. Westwood read a note from a correspondent, who had found the larvæ of Melöe in immense numbers on potato-plants "hanging in clusters like swarms of minute bees;" he also exhibited some of the larvæ which had been forwarded to him.

Mr. Janson exhibited two specimens, one of which he presented to the Society's cabinet, of Hypulus quercinus, *Payk.*, taken by him on the same stump of oak which yielded the species last year at Colney Hatch.

Mr. Smith announced that Mr. Frederick Grant had recently discovered colonies of Tapinoma erratica at Wimbledon and Weybridge; he also exhibited the female of this species from the latter place, being the only British specimen of that sex hitherto captured.

Mr. Edward Sheppard exhibited three specimens of Drypta emarginata, found by Mr. Arthur Adams under a tuft of grass near Portsmouth, but about two miles inland.

Mr. Stainton exhibited a number of very accurate drawings of the transformations of Micro-Lepidoptera, made by Herr Grabow, of Berlin, among which the most interesting was that of Asychna æratella, which feeds in a pod-like excrescence which it appears to form on the shoots of Polygonum aviculare, in autumn.

Mr. Hunter exhibited a female Stauropus Fagi, recently taken at Black Park, and also the young larvæ about thirty-six hours old, produced from eggs laid by this specimen.

Anommatus and Langelandia.

The President stated, with reference to the communication made by him at the last Meeting from Mons. Charles Delarouzée, that he had recently been informed by that gentleman that the water-butt alluded to was sunk in the earth to the depth of three feet, which would account for his having found the insects then mentioned three feet below the surface; he added, that he had no doubt, by searching in similar situations in this country, we might discover both Anommatus and Langelandia.

Observations on the Habits of two species of Mygale.

Under the above title, Mr. Smith read the following notes, by Mr. H. W. Bates:—

"With regard to spiders, there is one observation I made, which I am sure will be of the highest interest to Science: it is with respect to the habit of the genus Mygale to prey on birds. Now, I have detected them in this fact as far back as 1849, but thought little of it at the time, as I had the idea that it was a well-known and undisputed fact in Science. Lately, however, I read an account (I think, in 'Langsdorff's Expedition in the Interior of Brazil'), where the fact is considered to rest on no foundation, and to be one more of the fables originated by Madame Merian.

"Now, I will relate to you what I saw in the month of June, 1849, in the neighbourhood of Cametá; I was attracted by a curious movement of the large gray-brown Mygale on the trunk of a vast tree: it was close beneath a deep crevice or chink in the tree, across which this species weaves a dense web, open for its exit and entrance at one end. In the present instance the lower part of the web was broken, and two pretty small finches were entangled in its folds; the finch was about the size of the common siskin of Europe, and I judged the two to be male and female; one of them was quite dead, but secured in the broken web; the other was under the body of the spider, not quite dead, and was covered in parts with the filthy liquor or saliva exuded by the monster. I was on my return from a day's excursion by land at the time, with my boxes full of valuable and delicate insects and six miles from my house, and therefore could not have brought the specimens home, even if I had wished, which I did not, as the spider was a very common species, easily to be procured nearer home. The species I cannot name; I sent several fine specimens, stuffed, to London, in 1851; it is wholly of a gray-brown colour and clothed with coarse pile. Doubtless, you will immediately know the exact species to which I refer.

"If the Mygales did not prey upon vertebrated animals I do not see how they could find sufficient subsistence.

"On the extensive sandy campos of Santarem, so bare in vegetation, there are hundreds of the broad slanting burrows of the large stout species (that fine one, dark brown, with paler brown lines down the legs, of which I sent specimens in 1851). The campos, I know, from close research, to be almost destitute of insects, but at the same time swarm with small lizards, and some curious ground finches of the Emberiza group (one of which has a song wonderfully resembling our yellow bunting of England), besides which, vast numbers of the Caprimulgidæ and ground doves lay their eggs on the bare ground. I believe this species of Mygale feeds on these animals and their eggs at night. Just at the close of day when I have been hurrying home, not liking to be benighted on the pathless waste, I have surprised these monsters, who retreated within the mouths of their burrows on my approach."

Some conversation ensued on the supposed poisonous nature of spiders, and the strength of the webs formed by various species, in which the President, Mr. Westwood, Mr. Meade, Captain Cox, &c., took part.

Note on Otiorhynchus sulcatus.

Under this title Mr. Newman read the following paper :—

"In the later months of summer this weevil may frequently be seen crawling about the wood-work of the fern-house, especially at night; and who does not visit his fernery by night? But occasionally you may also find the female clinging to the stipes or frond-stalks, especially of Adiantum, Cystopteris and Asplenium, genera which send up fronds in succession until the stalks look like a little forest: nestled among these, and with its head upwards, it drops its small white globular eggs, which fall quite free, and seem neither to attach themselves by any viscid covering nor to be attached designedly by the parent to the frond-stalks or other substances which may happen to be at hand. We must allow imagination to picture the hatching of the egg and the descent of the tiny grub: I find the juvenile depredators a few days afterwards ensconced in snug little cavities of the caudex scarcely large enough to admit the head of the smallest pin: they are now minute, jelly-like, transparent legless maggots; I say jelly-like, because the word describes their appearance with great exactness; but it must not be understood as implying the possession of the moist or mucous surface distinctive of the larvæ of some Coleopterous and Hymenopterous insects: on the contrary, the surface of these little grubs might be described in the words of pleasant old Gerarde, as clean and 'dry in the first degree:' after feeding for a very few days the colour of the grub becomes opaline and slightly opaque, the opaline tint being caused by the quantity of food in the intestines; this food becomes more and more apparent, as long as the grub continues to feed. The cavities in the caudex of the fern now rapidly become larger, and the effect is very visible above ground. When the grub is feeding most eagerly it is spring; and, one after another, the Ionic volutes of the nascent circinate fronds droop, wither and fall, plainly proclaiming the presence of the sapper and miner at work below, the canker-worm at the seat of life. When its appetite is at length satiated, the grub becomes quite opaque, and of a uniform cream-colour; the food disappears from the intestinal canal, and the creature withdraws about three-quarters of an inch from the scene of his labours. We use a light sandy soil for the ferns, and the grub seems to find no difficulty in making his way through this, and adapting it to his purposes; for he now forms a circular cell, quite large enough for himself and two friends, although he never invites them; and he polishes up the walls of this cell in the nicest and neatest manner; and, without using silk of his own spinning, or any other material except the often-watered earth, he makes every thing snug and comfortable, and settles himself in for a fortnight's rest, during which he practises total abstinence, as if to atone for his former voracity. I will describe the grub in this state of abstinence and rest. Length, ·4125 inch; greatest breadth, *i.e.* at one-third of the length between the head and the anal extremity, ·151 inch: head testaceous, horny, very shining, gibbous in front, rounded at top, truncate below at its greatest diameter, having therefore the figure of a beehive: beneath the truncature protrudes the labrum, which exhibits the anomalous or previously unobserved character of a curious pectinated process at each angle,—two strong, incurved, testaceous mandibles, having a blunt tooth near their black tip, or, perhaps, more correctly characterised as being obtusely bifid at the apex,—two maxillæ, much smaller and less conspicuous than the mandibles, but horny and glabrous; internally and apically the maxillæ bear an obtuse lacinia, having a serrated, subspinous, internal margin; externally they bear a biarticulate palpus, the basal joint of which is stout and nearly globose, the apical joint rather longer, cylindrical, and somewhat obtuse,—finally, a labium, long and narrow, bearing at each external angle a biarticulate palpus, much resembling those of the maxillæ. The body is composed of twelve segments, of which the first seems to have only its sternal surface developed, and the twelfth is little more than a tubercle; on the second on each side near the head is a circular spiracle, the only one that I can find: there are no legs, but each segment has a series of papillæ and a number of strong testaceous bristles; aided by which, the grub has very considerable powers of locomotion when placed on a somewhat uneven surface. At the expiration of a fortnight the larval state has ceased and that of pupa has been assumed; this undergoes changes of colour very much like those of the larva; at first it is hyaline, then slightly opaline, and finally cream-coloured, with very conspicuous black eyes: the peculiarities of a necromorphous pupa are now so familiar to entomologists that I need not dwell on them; every limb is free, and every joint of the antennæ and tarsi is discernible through the slender pellicle with which it is invested; the elytra, attached to the dorsal surface at the anterior margin of the mesonotum, at first bend forwards, and passing between the middle and hind legs, repose on the latter, which, in their turn, are neatly arranged in front, reposing on the sternum. An unexplained phenomenon must be noticed here; a considerable number of the pupæ, say one in nine, present an atrophied or shrunken appearance, and these, not possessing sufficient vitality to carry them through the final change, die, turn black, and eventually decay: coexistent with these atrophied pupæ is the presence of a certain myriapod, which I believe to be the young of Lithobius forcipatus; but the connexion between the myriapod and the weevil still remains to be unravelled. The pupa state, like that of the larva after it leaves off eating, lasts about a fortnight, and it takes another fortnight at least for the weevil to become hard and fitted for a more locomotive life; so that six weeks are occupied from the formation of the tomb-like earthy cell to the time for finally quitting it. The beetle, when first emancipated, is of a dull white colour; it soon turns to a pale, testaceous brown, which gradually becomes darker and darker, until the final deep hue and hardened surface are attained: it then breaks the walls of its self-constructed prison and crawls solemnly and slowly about the greenhouse, probably in quest of amorous adventures, to be followed by those

parental duties, which are a necessary consequence of that command which went forth at the beginning to weevils as well as to man, 'Increase and multiply.' It is more than twenty years since I first traced the history of this insect, which is a most dangerous enemy to the horticulturist: my observations were then directed to its operations on Saxifraga sarmentosa, the crown of leaves and flowering stalks of which I constantly found completely severed from the roots by this subterranean marauder, but I think this is the first time it has been noticed in connexion with ferns."

Insects injurious to Forest-trees.

Captain Cox remarked that Chrysoclista Linneella was swarming on the trunks of lime-trees in Hyde Park, the bark of the trees in many places being almost destroyed by the larvæ: he also alluded to the destruction now progressing of many fine elms and other trees in the parks by the Scolytus, &c., and regretted that those in authority would not adopt the very simple means to remedy the evil.—*E. S.*

Proceedings of Natural-History Collectors in Foreign Countries.

MR. A. R. WALLACE.*—"St. Munjon Coal Works, Borneo, 8th April, 1855. You will see by the heading of this letter that I have changed my locality. I am now up the river Sadong, about twenty miles N.E. of Sarawak. A small coal-field has been discovered here, and is now being worked. At present the jungle is being cleared, and a road made to carry the coals to the river side, and it is on account of the scarcity of roads in this country that I thought it advisable to come here. Another reason was, that this is the district of the "Mias" or Orang-utan, the natural history of which I am very anxious to investigate, so as to determine definitely whether or no three species exist here, and also to learn something of their habits in a state of Nature. An English mining engineer has the direction of the works here, and has about a hundred Chinese labourers engaged. I am residing with him, at the foot of the hill in which the coal is found. The country all round us is dead level and a perfect swamp, the soil being a vegetable mud, quite soft, and two or three feet deep, or perhaps much more. In such a jungle it is impossible to walk; a temporary path has, however, been made from the river (about a mile and a half) by laying down trunks of trees longitudinally. Along this path is very good collecting-ground, but many fine insects are daily lost, and butterflies can hardly be captured at all, from the impossibility of stepping out of the path, and the necessity of caution in one's movements

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*** Communicated by Mr. S. Stevens.**

to preserve balance and prevent slipping, not at all compatible with the capture of active tropical insects. The small clearing in which our houses are situated also furnishes me with many good insects among the trunks and stumps, and other decaying timber. Half a mile further on in the jungle, on the hill side, is another clearing, where coal levels are to be opened; and, lastly, the jungle is being cut down to form a road or railway, and which, as it progresses, I expect will offer me very fine collecting-grounds. Having now been here nearly a month I can offer some opinion on its entomological capabilities. Imagine my delight in again meeting with many of my Singapore friends, — beautiful longicorns of the genera Astathes, Glenea and Clytus, the elegant Anthribidæ, the pretty little Pericallus and Colliuris, and many other interesting insects. But my pleasure was increased as I daily got numbers of species, and many genera which I had not met with before. Longicorns I think are more abundant than at Singapore, and more than half of them are new to me. The species, too, run a size larger. Some of the scarcest there are here the most abundant, while many of the commonest of that locality seem to be altogether absent from this. Curculionidæ are about equal in number, and there is a fair proportion of novelty. Two or three species closely allied to the Mecocerus Gazella are abundant, and many curious Brenthidæ. I am paying much attention to the most minute species, and can safely promise abundance of novelty for Mr. Waterhouse. Carabidæ are hardly so abundant as at Singapore, but I have some beautiful new Therates, Catascopus and Colliuris, and the curious Thyreoptera also occurs sparingly under Boleti. The Cleridæ seem very similar to those of Singapore, but scarcely so numerous. The Buprestidæ I am happy to say are very fine; not that the species run very large, but they are tolerably abundant. One of the most beautiful I make out to be Belionota sumptuosa, about an inch long, and of the richest golden copper-colour; it flies with the greatest rapidity, making a loud bee-like hum, and settles on timber only in the hottest sunshine. There are also many smaller species of a dark green, variously marked with lighter green or golden spots (Chrysobothris sp.?). Also several slower flying kinds, which when fresh are clothed with a yellow powder, like the Euchroma gigantea? of Brazil, which, however, seldom reaches England in that condition, as it is difficult to capture and kill the insect without injuring its delicate covering. I have also some very curious minute species, making altogether thirty-six species of this interesting family collected in Borneo. I also pay much attention to

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NOTICE TO ENTOMOLOGICAL AUTHORS.

WANTED, a MONOGRAPH of the BRITISH EUPITHECIÆ. Every species to be carefully described, and the characters by which it is istinguished from the allied species to be fully mentioned: the habits and food of the arvæ, if known, to be given, and as many larvæ as possible described.

Those desirous of entering into an engagement to supply this want are requested o communicate with me on or before FEBRUARY 1st, 1856.—H. T. STAINTON.

Fifteen Pounds will be paid for the Manuscript.

N.B.—The Monograph of the Tortricina is in hand.

TO COLLECTORS OF BRITISH BIRDS, INSECTS, &c.

H. BURTON & C. DAVEY, of 66, HIGH ST., CAMDEN TOWN, beg to state that they have opened at MADAM TUSSAUD'S BAZAAR, aker Street, Portman Square, A SHOW-ROOM, fitted up in a superior manner ith *Aviary, Fountain, &c.*, where will be continually kept on sale a choice collection of iving and Stuffed British and Foreign Birds, also Birds' Eggs and Entomological pecimens, in great variety and excellent preservation.

⁂ *Entomological Apparatus, Cabinets for Eggs, &c., manufactured to order on the most economical terms.*

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TO CORRESPONDENTS.

The length to which Dr. Knox's valuable papers on the Salmon have extended, has necessarily excluded a great number of shorter communications, but I am happy to say that the whole of these are arranged for publication, and will certainly appear in the September number. In Entomology, the present season has been a most favorable one, many rarities having occurred in abundance: a single specimen of the previously doubted Trochilium Chrysidiforme has been taken by Mr. Brewer, of Reigate: several specimens of Acontia luctuosa and Polia herbida, in abundance, have been taken by Mr. Bouchard in Darenth Wood. I have taken the water-net in hand, after having allowed it to remain idle for a quarter of a century, and have prepared a few notes of the results for publication when the more valuable communications of my friends do not require the whole of the space allotted to the monthly number.

REDUCED BOOK POSTAGE.

The *Reduction of Postage* on books is a great boon to Science in all its departments, and those engaged in the book-trade will, of course, largely avail themselves of the *New Regulations*. I shall be happy to post, on the usual *Magazine-day*, that is, the last day of every month, free of all charge for carriage, the consecutive numbers of the 'Zoologist,' so that they will make their appearance on the breakfast-tables of the subscribers on the 1st of each month: the same rule will apply to any single Number or series of Numbers; to any Volume or series of Volumes. All the *Catalogues of the British Museum* will also be forwarded in the same way, the only condition required, being the pre-payment in Postage-stamps of the price of the book ordered. A copious list of the most useful books in every branch of the Science is in course of preparation, and will appear on the wrappers of future numbers.

Supposed New Annelide.—There is, and has been for some months past, in the smallest central tank in the Marine Aquarium of the Zoological Society, Regent's Park, London, a very remarkable annelide with a gelatinous tube, which no one seems to be able to identify: it appears to be related to the Sabellæ. I send this note to the 'Zoologist' in the hope that some naturalist who may be visiting the Gardens will be able to recognise and name it. The attendant, Mr. James Tenant, will point it out to any inquirer.—*W. Alford Lloyd; 164, St. John Street Road, Islington, July* 25, 1855.

EDWARD NEWMAN, PRINTER, 9, DEVONSHIRE STREET, BISHOPSGATE